Steep ramp of '124 is a major safety problem, but one that has to be lived with. Note protective coverings on thrust chamber, fin tip, radome.

"TOGETHERNESS"

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Airlifting the IM-99A missile, like marriage, demands a certain amount of "togetherness" between Air Force and contractor. Two birds per airlift are onloaded by Boeing people and offloaded by Air Force people; in between is an airborne MATS C-124. One loading operation is a mirror-image of the other, and similar accidents can happen at both places. Let's look at a few of the safety hazards that have to be taken into account when Bomarcs are shipped. . . .

In the July 1960 issue of *Aerospace Safety,* mention was made of the second Air Force-Industry conference on missile safety; and of plans to create Air Force-Industry Accident Review Boards. If future emphasis is to be placed on such joint action, much can be gained from a positive, realistic—above all, cooperative—approach to safety problems.

Cooperation is even more important where the problem area is double-ended: where both contractor and military personnel perform the same job and are subject to the same safety hazards. Therefore, in the following discussion of one such area—that of Bomarc transportation—any references to slip-ups on the military end of the airlift are meant to be strictly nonpartisan and objective. As long as there have been near accidents, it's better to use them as a guide for future safety than to pretend they never happened.

As this article goes to press, the safety record of Bomarc airlifts can be summed up in four words: so far, so good. You may recall, however, the optimist who jumped off the top of a New York office building. He was heard to yell the same thing as he passed the 20th floor: so far, so good.

This is not to imply—necessarily—that IM-99A on and offloading crews have been living on borrowed

Closeup of trailer shows hand brake linkage, towing cable. Handle forward of hand brake is steering selector. Two rings support missile in plane cradles.

time. Nor—necessarily—that the end of the winning streak, when it comes, will be as tragic as impacting against a concrete surface at 175 or so mph. But then again . . .

Let's look at some of the near misses. One crew member got his foot run over by the aircraft loading trailer. But he was wearing safety shoes, as he was supposed to. Once a lifting cable failed and a missile was dropped about six inches during an offload operation. Nothing happened: no explosions, no mangled human extremities; because explosive items like squibs and initiators are shipped separately, and because the hands and feet of loading personnel were clear of the danger area. Once a failed pin in the aircraft hoist gear sent a missile and trailer rumbling down the loading ramp at a clip which might have compared favorably with airborne cruise speed to anyone in the way. But nobody, luckily, was *in* the way. Everyone had been paying attention to the 2 dash 2's oft-repeated warning (repeated an even dozen times, to be exact): "Keep personnel away from down-ramp end of trailer as it is being pulled up (or rolled down) loading ramp."

Still, if you took a dim and rigorous view of these three incidents, you would conclude that personnel were only practicing about half the safety they should have been. Otherwise we wouldn't be using the words "near miss." Good safety practices, we know, are redundant. Just as there are two or three different ways to trigger an ejection seat, so there are extra, redundant, "insurance" features associated with airlifting the IM-99A. For example: at the crucial moment when the trailer is stopped on the ramp while cargo is being shifted inside the plane, four conditions would have to exist before anyone could be hurt by a runaway missile and trailer:

(1) A hasty and incomplete preliminary inspection of loading gear: trailer, cable, snatch blocks, Pullift hoists, etc.;

(2) Disregard of the warning in the 2 dash 2 about staying clear of the downramp end of the trailer;

(3) Failure to attach the safety restraint chains which are normally hooked between the loading trailer and the body of the C-124; and

(4) Failure to set the trailer hand brake. Each procedure serves to back up the others. Two are physical restraints; two depend on the human element. All are essential for 100 per cent safety.

So much for near misses where "insurance" paid off. There have also been cases where survival was strictly a matter of luck. The incident that comes most readily to mind happened a short while ago, during a two-missile offloading. Normal sequence is to move the port missile all the way aft in the C-124, load the starboard missile on the offloading trailer, and steer missile and trailer on down the ramp. The manual says: "Station one man at hydraulic hand pump and gage position at right rear of trailer and one at hand brake and directional valve position at left rear of trailer. Station others as needed to observe and direct trailer loading." "Rear of trailer" in these instructions means forward in the plane; or the end closest to the ramp. On this particular operation, however, it seems there was also a man—call him Smith—on the *front* end of the trailer (aft in the C-124), riding on the chassis to control a parking brake. As the outgoing missile passed by the elevator stub of the other missile, Smith got wedged in between. Fortunately, another crewman, stationed near the back end of the trailer, had both Smith and the anchor vehicle operator in his line of vision. He saw what was happening and signalled the wrecker operator to stop towing. Smith was extricated from a squeeze which could have been fatal. To quote from a subsequent field report: "At this point the crewman is on the trailer controlling the emergency (parking) brake. His back is extremely close (brushes) the elevator stub of the other missile . . . Should anything happen at this instant, the crewman's life would be in danger."

Boeing engineers tackled the problem raised in this field report, and came up with the following recommendations:

(a) Steer the trailer with the steering selector which is closest to the front of the C-124, 'til Smith's station is clear of that elevator stub.

(b) The only break to be used during loading is the hand brake. The parking brake—required by MIL-M-8090—is only to keep the empty trailer from breaking loose, and should not be used when the missile is aboard. A lot of force has to be put on this brake to hold an *empty* trailer on a 17° incline, so it would be virtually useless as a physical restraint on missile and trailer.

(c) Finally, to quote again: "There is no T. O. requirement for a man to ride the trailer. A man riding the trailer during operation is subject to any accident that might happen to the trailer."

Before we criticize Smith too severely, however, we should note that his purpose in riding the trailer was apparently to add still another item of safety insurance to the four mentioned previously. So that the intention, at least, was good.

Technical Manual T. O. 21-IM99A-2-2 is the bible for Bomarc airlift loading procedures. Updated every three months, these 2 dash 2 instructions are the end product of dozens of on-the-spot observations at both on and offloadings, conferences with handling equipment design engineers, and coordination with Safety Engineering. The latter group utilizes extensive test facilities and works along with other groups, like Reliability and Human Factors engineering, to solve safety problems which have already arisen and to find out how future ones can be prevented. Often, solutions to local, in-house contractor problems can be applied to similar conditions in the field.

For at least two men, however, safety is consider-

One mistake and a lot of money has been wasted when you're moving a missile to its new home. It's a job requiring detailed safety on all sides. Togetherness, then, is the word.

ably more personal than anything written in the manual or in a test report. On the day of the airlift, safety of the C-124 and the missiles inside is largely up to the MATS loadmaster and one engineer from Boeing's Missile Delivery Group.

They're both out on the flight apron at 0700. Together they hold a thorough, nit-picking inspection: checking the housekeeping around the loading area and in the plane, determining the exact condition of all loading gear. The next thing is to decide *where* to put *what* in the cargo spaces. To have a safe flight, the center of gravity of the plane must stay between certain body stations. Almost always there is extra freight, like batteries and test sets, to be sent along with missiles and airfoils. Tiedown methods have to be agreed on. Both engineer and loadmaster must be able to think on their feet and make rapid decisions and adjustments in case an item of freight doesn't show up, or if more shows up than they expected. Exact placement of cargo and exact fuel requirements are therefore figured down to the last inch and gallon by two heads containing a sum total of years of air-cargo knowhow and experience. Aiding their calculations are the engineer's conventional slipstick, and the loadmaster's load adjuster, marked off in body stations and fuel loads, and serialized to his C-124 and that plane only.

Boeing personnel, supervised by the loadmaster, perform the actual onloading. Their procedures follow the lines set down by the 2 dash 2, with certain sophistications. The loading trailers here at Seattle—referred to, for some obscure reason, as "tomato" dollies—are smaller and lighter than those in use at the other end. This makes for speed and safety in loading, since less strain is put on the loading gear.

Now don't everybody yell at once. We know there aren't any of these out at the bases. And for a very good reason, too. Sure, maybe the light trailers speed things up. But they are too light for safe over-the-road transportation—too fragile, and not built to ICC specifications. This is OK at Seattle, where there is no "over the road"; only a few yards over a smooth flight apron, between the storage area and the '124. But at a tactical base, the distance between the airhead and the Bomarc site is often quite a stretch, and the trailer must be rugged enough to take a long haul.

Positive, error-proof communication between loadmaster and anchor winch is provided at onloadings by a three-light system which looks like an ordinary traffic signal. Red means "stop," green means "wind in cable," amber means "let out cable." One big advantage is that the system works efficiently even around a high noise level area. And with '707s, B-52s, KC-135s and other heavies warming up, taxiing and taking off most of the time, that noise level can get pretty high.

We are not saying that the Seattle end of the airlift is ultra-safe and can do no wrong, while the other end is a horde of accident-prones. The Boeing crew doesn't wear safety shoes. The bases don't have the three-light system. So who is safer than who?

The thing to remember is that this whole business of airlifting the IM-99A continues under a set of conditions which—let's face it—we all have to live with. For one thing, the loading ramp of the C-124 is inclined 17° to the horizontal. We can figure out from simple trigonometry that a shallower ramp would mean less pull on the hoist cable and its associated gear, and therefore safer operation. The C-133, it so happens, has a shallower ramp. Unfortunately, not many C-133s are available, nor as of this writing are they likely to be. In addition, the '133 does not come equipped with a cargo hoist, which means that even if we could get this aircraft, each missile would have to be shipped on its own individual trailer. So the '124 and its steep ramp are here to stay.

Another thing both ends must realize is that loading crews get used to working together. MATS likes to rotate loadmasters on these airlifts, to spread the experience around. But in places with a low turnover rate, missile stevedoring would be performed by a more or less integrated team, who knew each others' idiosyncrasies, who had evolved certain private hand or verbal signals valid only for the team itself. Up to a point, nothing is wrong with this approach. MATS has been in business since 1948, and airlifts have been going on nearly as far back as the Wright brothers. During that stretch, a lot of knowledge has been accumulated. The rules on missile transportation—safety and otherwise—are based solidly on common sense, and if the same crew has been working together over a period of time, such "in-group" communication can speed things up. But now, take for instance the crewman who nearly got squashed between two missiles. Suppose the man who signalled his plight to the anchor vehicle had started dancing around, waving and yelling. Suppose the winch operator had been a new man, not thoroughly briefed on signals. To him, such apparently random signalling could have meant "go faster," "the trailer just ran over my foot," "the general is coming," or just about anything. If he had thought to himself, "maybe he means I should take in more," and thereupon started reeling in cable fast and furiously, the IM-99A airlift would have chalked up its first fatality. The moral is simply that everybody engaged in the operation should be told beforehand what each signal means and the information checked and double checked before on or offloading ever begins.

These are probably the two major problems: slope of the ramp and positive communication. But when you come right down to it, the others are equally as important; areas like trailer and hoist maintenance, safety training, proper use of protective covers. Too often and too easily these areas can be dismissed with the formula: "Not applicable; this is an Air Force problem." At the risk of belaboring the obvious, it would seem that the difference between getting killed and living to a ripe old age ought, by every rule of common sense, to be everybody's problem.

Chain Robbins, Safety Engineering Group Supervisor at Boeing, has put it this way: "One of the most unpleasant things about this business is the day you suddenly realize that many of the safety codes the Air Force and Industry have were generated out of tragedy —someone killed, someone mangled for life. You might say one of the objectives of the safety movement, which got under way around 1911, is to generate codes from tests, studies of human reactions, statistical data, near misses, everything we can get, to prevent future tragedies from ever happening."

There has never been a tragedy on any Bomarc airlift. Yet. ★